ISO TC 184/SC4/ WG12 N 425 **Date:** 1999–09–10

Supersedes ISO TC 184/SC4/ WG12 N 201

ISO 10303-517
Product data representation and exchange — Application interpreted construct — Mechanical design geometric presentation

ABSTRACT:
This document specifies the application interpreted construct for the description of structures for a limited visual presentation of wireframe, surface, and solid models as used in mechanical design. The projection of the 3D-models onto the plane of the display and specification of point, curve, and surface styles are included. Light sources, shading, and reflectance, the concept of layers, and the representation of text are out of scope.
KEYWORDS: application interpreted construct, camera model, curve style, surface style

COMMENTS TO READER:
This document has been reviewed and noted by the ISO TC 184/SC4 Quality Committee and SC4 secretariat and has been determined to be ready for this ballot cycle. It was prepared for distribution as IS release version. The AIC is in accordance with the comments from the DIS ballot of this part of ISO 10303 in May 1999.

Project Leader: Martin Philipp
Address: DiK
Darmstadt University of Technology
Petersenstr. 30
D–64287 Darmstadt
Germany

Telephone: +49 6151 16 3894
Telefacsimile: +49 6151 16 6854
Email: philipp@dik.tu-darmstadt.de

Project Editor: Martin Philipp
Address: DiK
Darmstadt University of Technology
Petersenstr. 30
D–64287 Darmstadt
Germany

Telephone: +49 6151 16 3894
Telefacsimile: +49 6151 16 6854
Email: philipp@dik.tu-darmstadt.de

Contents

Page

International Organization for Standardization
Case Postale 56 • CH-2111 Genève 20 • Switzerland

Printed in Switzerland

Figures

Tables

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303–517 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration,* Subcommittee SC4, *Industrial data.*

This International Standard is organized as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303–1.

A complete list of parts of ISO 10303 is available from the internet:

http://www.nist.gov/sc4/editing/step/titles/

Annexes A and B form an integral part of this part of ISO 10303. Annexes C and D are for information only.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organized as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303–1. This part of ISO 10303 is a member of the application interpreted constructs series.

An application interpreted construct (AIC) provides a logical grouping of interpreted constructs that supports a specific functionality for the usage of product data across multiple application contexts. An interpreted construct is a common interpretation of the integrated resources that supports shared information requirements among application protocols.

This document specifies the application interpreted construct for the description of the visual presentation of the shape of mechanical design models. Shape is projected into a plane display area. The projections themselves are not represented, however the shape and corresponding projection algorithms are given. Presentation attributes are included, such as line font and colour, that may be applied to parts or all of wireframe, surface, and solid models. Association of attributes with topological items is included to provide for the styling of high level shape constructs. Advanced visualization capabilities, such as light sources and surface reflectance are not included. The representation of annotation, such as text and symbols, are not specified.

Industrial automation systems and integration — Product data representation and exchange — Part 517: Application interpreted construct: Mechanical design geometric presentation

1 Scope

This part of ISO 10303 specifies the interpretation of the integrated resources to satisfy requirements for the description of the visual presentation of geometric shape. Only basic presentation attributes, such as colour or linefont, can be associated with points, curves, surfaces, and topological constructs. Advanced visualization functionality such as light sources and surface reflectance are not included. The description of annotation is not included. Also, the representation of the products themselves is out of scope.

The following are within the scope of this part of ISO 10303:

— the visual presentation of mechanical design shape representations;

— the assignment of visual presentation attributes to geometric and topological items;

— algorithms for the projection of 3D shapes into planes;

— the location of shape projections within a window;

— multiple views within one window;

— the background colour of a window;

— point and curve colour;

— point font;

— curve font;

— curve styles dependent on the role of the curves in the definition of a surface;

EXAMPLE Boundary curves and grid curves play different roles in the definition of a surface.

— pre-defined colours;

— pre-defined curve styles.

The following are outside the scope of this part of ISO 10303:

— the presentation of annotation, i.e., text and symbols;

— the assignment of geometric items to layers;

— surface characteristics such as transparency and reflectance;

— multiple windows;

— representation of products;

— hidden line and hidden surface removal;

— surface colour;

— light sources.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10303. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8824–1:1995, *Information Technology – Open Systems Interconnection – Abstract Syntax Notation one (ASN.1) – Part 1: Specification of basic notation*

ISO 10303–1:1994, *Industrial automation systems and integration – Product data representation and exchange: – Part 1: Overview and fundamental principles.*

ISO 10303–11:1994, *Industrial automation systems and integration – Product data representation and exchange: – Part 11: Description methods: The* EXPRESS *language reference manual.*

ISO 10303–41:1994, *Industrial automation systems and integration – Product data representation and exchange: – Part 41: Integrated generic resources: Fundamentals of product description and support.*

ISO 10303–42:1994, *Industrial automation systems and integration – Product data representation and exchange: – Part 42: Integrated generic resources: Geometric and topological representation.*

ISO 10303–43:1994, *Industrial automation systems and integration – Product data representation and exchange: – Part 43: Integrated generic resources: Representation structures.*

ISO 10303–46:1994, *Industrial automation systems and integration – Product data representation and exchange: – Part 46: Integrated generic resources: Visual presentation.*

ISO 10303–202:1996, *Industrial automation systems and integration – Product data representation and exchange: – Part 202: Application protocol: Associative draughting.*

3 Terms, definitions, and abbreviations

3.1 Terms defined in ISO 10303–1

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303–1 apply:

— abstract test suite (ATS);

— application;

— application context;

— application protocol (AP);

— data;

— implementation method;

— information;

— integrated resource;

— interpretation;

— model;

— presentation;

— product;

— product data;

— structure.

3.2 Terms defined in ISO 10303–42

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303–42 apply:

— curve;

— surface.

3.3 Terms defined in ISO 10303–46

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303–46 apply:

— annotation;

— layer;

— picture;

— presentation information;

— RGB;

— symbol;

— synthetic camera model;

— visualization.

3.4 Terms defined in ISO 10303–202

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303–202 apply:

— externally defined;

— predefined.

3.4.1
application interpreted construct
a logical grouping of interpreted constructs that supports a specific function for the usage of product data across multiple application contexts

[ISO 10303–202:1996, definition 3.7.1]

3.5 Abbreviations

For the purpose of this part of ISO 10303, the following abbreviations apply:

AIC	application interpreted construct
AP	application protocol
ATS	abstract test suite
RGB	Red, Green, Blue colour space

4 EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources and contains the types, entity specializations, and functions that are specific to this part of ISO 10303.

NOTE 1 - There may be subtypes and items of select lists that appear in the integrated resources that are not imported into the AIC. Constructs are eliminated from the subtype tree or select list through the use of the implicit interface rules of ISO 10303-11. References to eliminated constructs are outside the scope of the AIC. In some cases, all items of the select list are eliminated. Because AICs are intended to be implemented in the context of an application protocol, the items of the select list will be defined by the scope of the application protocol.

EXPRESS specification:

```
*)
SCHEMA aic_mechanical_design_geometric_presentation;

    USE FROM geometry_schema                          -- ISO 10303-42
     (axis2_placement_2d,
      axis2_placement_3d);

    USE FROM measure_schema                           -- ISO 10303-41
     (positive_ratio_measure);

    USE FROM presentation_appearance_schema           -- ISO 10303-46
     (curve_style,
      curve_style_font,
      curve_style_font_pattern,
      fill_area_style_colour,
      invisibility,
      over_riding_styled_item,
      point_style,
      pre_defined_curve_font,
      presentation_style_by_context,
      styled_item,
```

```
      surface_side_style,
      surface_style_boundary,
      surface_style_control_grid,
      surface_style_fill_area,
      surface_style_parameter_line,
      surface_style_segmentation_curve,
      surface_style_silhouette,
      surface_style_usage,
      u_direction_count,
      v_direction_count);


    USE FROM presentation_organization_schema          -- ISO 10303-46
     (background_colour,
      camera_image,
      camera_model_d3,
      camera_usage,
      presentation_area,
      presentation_representation,
      presentation_size,
      presentation_view);

    USE FROM presentation_resource_schema              -- ISO 10303-46
     (colour_rgb,
      planar_box,
      planar_extent,
      pre_defined_colour);

    USE FROM product_property_representation_schema    -- ISO 10303-41
     (shape_representation);

    USE FROM representation_schema                     -- ISO 10303-43
     (mapped_item,
      representation);
(*
```

NOTE 2 - The schemas referenced above can be found in the following Parts of ISO 10303:

geometry_schema	ISO 10303-42
measure_schema	ISO 10303-41
presentation_appearance_schema	ISO 10303-46
presentation_organization_schema	ISO 10303-46
presentation_resource_schema	ISO 10303-46
product_property_representation_schema	ISO 10303-41
representation_schema	ISO 10303-43

4.1 Fundamental concepts and assumptions

This application interpreted construct provides a consistent set of entities for the representation of pictures.

EXAMPLE 1 Pictures of mechanical products that are in the design stage are examples of pictures supported by this AIC.

All pictures shall be presented in the same window on a display. A picture may include one or several views of a product shape. Only the association between product shape and its projection algorithms is represented, not the projections themselves. The structure for the management of pictures is implemented using entities **mechanical_design_geometric_presentation_area**, **presentation_view**, and **mechanical_design_geometric_presentation_representation**. The relationships between these entities are represented using the **mapped_item** and **representation_map** entities. A **mechanical_design_geometric_presentation_area** is a subtype of **presentation_area**. This subtype has been created for the purpose of this part of ISO 10303. All the contents of a window shall be included into one **mechanical_design_geometric_presentation_area**. A view is represented by a **presentation_view**. The view contains entity **camera_image_3d_with_scale** which has been created for the purpose of this part of ISO 10303. This entity references **camera_image** which has the information that is necessary to compute the projection of a shape; this information is included in the camera model. Only entity **camera_model_d3** shall be used as camera model; none of its subtypes is valid. Light sources and hidden line removal are not part of the camera model. **Camera_image_3d_with_scale** references not only the camera model, but links it with **mechanical_design_geometric_presentation_representation** which contains product shape descriptions. These shapes may or may not be styled.

The appearance of product shape may be specified using styles for **point**s, **curve**s, and **surface**s. Styles may also be assigned to topological elements of product shape. A style assignment is made by instantiating a **styled_item** which refers to a **representation_item** together with its **presentation_style_assignment**. For the purpose of this part of ISO 10303 a subtype of **representation** has been created, **mechanical_design_geometric_presentation_representation**, to collect all **styled_item**s for a **mechanical_design_geometric_presentation_area**.

The **presentation_style_assignment** of a **styled_item** affects the appearance of the referenced **representation_item** as well as the appearance of all **representation_item**s referenced directly or indirectly by that item. Only those **representation_item**s are affected that are not already styled. This means styling a styled **representation_item** has no effect. Styling a partially styled **representation_item** affects only the appearance of the unstyled parts. Styling an unstyled **representation_item** affects the appearance of the whole item. Only styled **representation_item**s may be presented. Whether they are actually presented depends also on other facts, like **invisibility**. This part of ISO 10303 does not make any statement about the effect if style conflicts occur.

EXAMPLE 2 A style conflict occurs, for example, when a **representation_item** is used by several **styled_item**s.

A **presentation_style_assignment** is used to assign styles to a **representation_item** independently from any presentation context. A subtype of **presentation_style_assignment**, the **presentation_style_by_context**, allows the assignment of style for a specific presentation context. A presentation context can be any **representation** or **representation_item**.

Point_styles allow the specification of the marker symbol, marker size, and colour to be used for presenting points.

Curve_styles allow the specification of curve fonts, curve width, and colour. The appearance of curve ends and corners, and of patterns for filling visible curve segments is not distinguished. A curve font specifies whether a curve shall be drawn using solid, dashed, or dotted lines. The specification of arbitrary patterns for curve fonts and the usage of externally defined curve fonts are not incuded. Curve fonts may be pre–defined. The entities used for the definition of curve fonts are **draughting_pre_defined_curve_font** and **curve_style_font**. The curve width shall be specified as a measure value.

Surface styles provide the resources to specify the visual appearance of surfaces. Separate surface styles may be applied to each side of a surface using entities **surface_style_usage** and **surface_side_style**. A surface side style may be any combination of fill area style, boundary style, silhouette style, segmentation curve style, control grid style, or parameter line style. The rendering of **curve**s and **surface**s is not included.

A fill area style specifies a style for presenting visible surfaces by mapping a coloured fill area upon them.

A boundary style specifies a curve style for presenting the boundary curves of a surface. If no boundary style is specified, the boundary curves shall not be presented.

A silhouette style specifies a curve style for presenting the silhouette curves of a surface. If no silhouette style is specified, silhouette curves shall not be presented.

A segmentation curve style specifies a curve style for presenting the segmentation curves of a surface. This style affects only surfaces which are divided into segments such as B–spline surfaces. If no segmentation curve style is specified, segmentation curves shall not be presented.

A control grid style specifies a curve style for presenting the mesh of control points which are used for the definition of a surface. This style affects only surfaces which are defined over a mesh of control points, such as B–spline surfaces. If no control grid style is specified, the control grid shall not be presented.

A parameter line style specifies a curve style for presenting iso–parameter lines of a surface. The number of parameter lines in each parameter direction has to be specified for this style. If no parameter line style is specified, the parameter lines shall not be presented.

The entities defining these surface styles are **surface_style_fill_area**, **surface_style_boundary**, **surface_style_silhouette**, **surface_style_segmentation_curve**, **surface_style_control_grid**, and **surface_style_parameter_line**.

Colours may be specified based on the RGB colour model using entity **colour_rgb** or by **draughting_pre_defined_colour**.

This part of ISO 10303 does not include constructs for the representation of annotation.

The following entities are intended to be independently instantiated in the application protocol schemas that use this AIC:

— camera_image_3d_with_scale;

— draughting_pre_defined_colour:

— draughting_pre_defined_curve_font;

— invisibility;

— mapped_item;

— mechanical_design_geometric_presentation_area;

— mechanical_design_geometric_presentation_representation;

— over_riding_styled_item;

— presentation_style_by_context.

4.2 aic_mechanical_design_geometric_presentation entity definitions

4.2.1 camera_image_3d_with_scale

A **camera_image_3d_with_scale** is a **camera_image** that projects three-dimensional geometry and has a derived scale. The scale is the ratio between the size of the viewport and the size of the **view_window** of the **view_volume**.

EXPRESS specification:

```
*)
ENTITY camera_image_3d_with_scale
  SUBTYPE OF (camera_image);
DERIVE
  scale: positive_ratio_measure := ((SELF\mapped_item.mapping_target\
         planar_extent.size_in_x) / (SELF\mapped_item.mapping_source.
         mapping_origin\camera_model_d3.perspective_of_volume.view_window.
         size_in_x));
WHERE
```

```
  WR1:  ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CAMERA_MODEL_D3'
        IN TYPEOF (SELF\mapped_item.mapping_source.mapping_origin));
  WR2:  aspect_ratio(SELF\mapped_item.mapping_target) =
        aspect_ratio(SELF\mapped_item.mapping_source.mapping_origin\
        camera_model_d3.perspective_of_volume.view_window);
  WR3:  SELF\mapped_item.mapping_source.mapping_origin\camera_model_d3.
        perspective_of_volume.front_plane_clipping
        AND
        SELF\mapped_item.mapping_source.mapping_origin\camera_model_d3.
        perspective_of_volume.view_volume_sides_clipping;
  WR4:  (SELF\mapped_item.mapping_target\planar_extent.size_in_x > 0)
        AND
        (SELF\mapped_item.mapping_target\planar_extent.size_in_y > 0);
  WR5:  (SELF\mapped_item.mapping_source.mapping_origin\camera_model_d3.
        perspective_of_volume.view_window.size_in_x > 0)
        AND
        (SELF\mapped_item.mapping_source.mapping_origin\camera_model_d3.
        perspective_of_volume.view_window.size_in_y > 0);
  WR6:  ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AXIS2_PLACEMENT_2D' IN TYPEOF (SELF\mapped_item.
        mapping_target\planar_box.placement))
        AND NOT ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AXIS2_PLACEMENT_3D' IN TYPEOF (SELF\mapped_item.
        mapping_target\planar_box.placement));
END_ENTITY;
(*
```

Attribute definitions:

scale: the **positive_ratio_measure** derived from the rectangular size of the viewport and the rectangular size of the **view_volume** of the **camera_model**.

Formal propositions:

WR1: The source of the projection shall be a **camera_model_d3**.

WR2: The aspect ratio of the viewport shall equal the aspect ration of the **view_window** of the **view_volume**.

WR3: The geometry of the projected representation shall be clipped against the plane represented by the **front_plane_distance** and the planes which are the sides of the volume defined by the **view_volume**.

WR4: The rectangular size of the viewport shall be specified by positive values.

WR5: The rectangular size of the **view_window** shall be specified by positive values.

WR6: The drawing space of a **camera_image_3d_with_scale** shall be specified in a 2D coordinate system.

Informal propositions:

IP1: The horizontal and vertical components of the viewport shall be parallel to the corresponding components of the **view_window** of the **view_volume**.

4.2.2 draughting_pre_defined_colour

A **draughting_pre_defined_colour** is a **pre_defined_colour** that is identified by name.

EXPRESS specification:

```
*)
ENTITY draughting_pre_defined_colour
  SUBTYPE OF (pre_defined_colour);
WHERE
  WR1:  SELF.name IN
              ['red',
               'green',
               'blue',
               'yellow',
               'magenta',
               'cyan',
               'black',
               'white'];

END_ENTITY;
(*
```

Formal propositions:

WR1: The name of the **draughting_pre_defined_colour** shall be 'red', 'green', 'blue', 'yellow', 'magenta', 'cyan', 'black', or 'white'.

Attribute value definitions:

Table 1 states the RGB values corresponding to each of the predefined colours that are specified by this part of ISO 10303.

4.2.3 draughting_pre_defined_curve_font

A **draughting_pre_defined_curve_font** is a **pre_defined_curve_font** that is identified by name.

Table 1 – RGB colours for predefined colours

Colour name	Red	Green	Blue
black	0.0	0.0	0.0
red	1.0	0.0	0.0
green	0.0	1.0	0.0
blue	0.0	0.0	1.0
yellow	1.0	1.0	0.0
magenta	1.0	0.0	1.0
cyan	0.0	1.0	1.0
white	1.0	1.0	1.0

EXPRESS specification:

```
*)
ENTITY draughting_pre_defined_curve_font
  SUBTYPE OF (pre_defined_curve_font);
WHERE
  WR1:  SELF.name IN
              ['continuous',
               'chain',
               'chain double dash',
               'dashed',
               'dotted'];
END_ENTITY;
(*
```

Formal propositions:

WR1: The name of the **draughting_pre_defined_curve_font** shall be 'continuous', 'chain', 'chain double dash', 'dashed', or 'dotted'.

Attribute value definitions:

Table 2 states the lengths of each line segment and space, in millimetres, corresponding to each of the predefined curve fonts that are specified in this part of ISO 10303. If the **pre_defined_curve_font** is used as part of the definition of a **curve_style_font_and_scaling**, then the given lengths are those when the **curve_font_scaling** attribute has the value 1.0.

NOTE 1 - The **curve_style_font_and_scaling** entity is defined in the **presentation_appearance_schema** in ISO 10303-46.

NOTE 2 - Illustrations of curve fonts are given in Figure 1.

Table 2 – Line segment and space lengths for predefined curve fonts

Curve pattern name	Segment (mm)	Space (mm)	Segment (mm)	Space (mm)	Segment (mm)	Space (mm)	Number of segments
continuous							0
dashed	4.0	1.5					2
chain	7.0	1.0	1.0	1.0			4
chain double dash	7.0	1.0	1.0	1.0	1.0	1.0	6
dotted	1.0	1.0					2

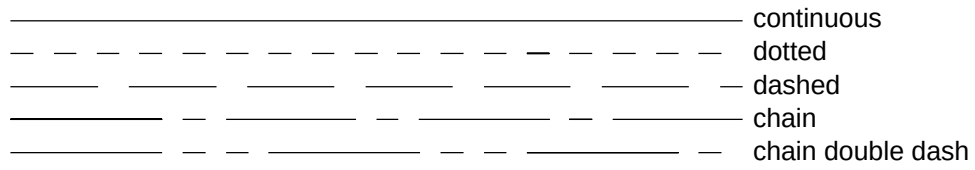

Figure 1 – Illustration of predefined curve fonts

4.2.4 mechanical_design_geometric_presentation_area

A **mechanical_design_geometric_presentation_area** contains information that is needed to determine the projection from some mechanical design model to a corresponding picture on a screen. The design model may be represented by any type of shape, such as a wireframe, surface, or solid. A **mechanical_design_geometric_presentation_area** is a **presentation_area** that is restricted to a certain presentation hierarchy. A **mechanical_design_geometric_presentation_area** shall be a single–window presentation of a product; no other **presentation_areas** shall be included in a **mechanical_design_geometric_presentation_area**. The model that is presented shall be a **mechanical_design_geometric_presentation_representation**. The camera model used shall neither include light sources nor hidden line removal nor hidden surface removal, but shall be a **camera_model_d3**.

EXPRESS specification:

```
*)
ENTITY mechanical_design_geometric_presentation_area
  SUBTYPE OF (presentation_area);
WHERE
  WR1:  -- only presentation_views or axis2_placements in
        -- mechanical_design_geometric_presentation_area
        SIZEOF(QUERY(it1 <* SELF.items |
        NOT (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.AXIS2_PLACEMENT'
        IN TYPEOF(it1))
```

```
        OR
        (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.MAPPED_ITEM'
        IN TYPEOF(it1)) AND
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.PRESENTATION_VIEW'
        IN TYPEOF
        (it1\mapped_item.mapping_source.mapped_representation))))))) = 0;
  WR2:  -- only mechanical_design_geometric_presentation_representation
        -- via camera_image_3d_with_scale or axis2_placements in
        -- presentation_views
        SIZEOF(QUERY(pv <* QUERY(mi1 <* QUERY(it1 <* SELF.items |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.MAPPED_ITEM'
        IN TYPEOF(it1)) |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.PRESENTATION_VIEW'
        IN TYPEOF
        (mi1\mapped_item.mapping_source.mapped_representation)) |
        -- search in all presentation_views for axis2_placements and
        -- mapped_items and for the subtype of mapped_item
        -- camera_image_3d_with_scale; the latter shall reference
        -- a mechanical_design_geometric_presentation_representation;
        -- the supertype mapped_item shall reference presentation_view.
        NOT (SIZEOF(QUERY(it2 <* pv\mapped_item.mapping_source.
        mapped_representation\representation.items |
        NOT (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.AXIS2_PLACEMENT'
        IN TYPEOF(it2))
        OR
        (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.MAPPED_ITEM'
        IN TYPEOF(it2)) AND NOT
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'CAMERA_IMAGE_3D_WITH_SCALE' IN TYPEOF(it2))) AND NOT (
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.PRESENTATION_VIEW'
        IN TYPEOF
        (it2\mapped_item.mapping_source.mapped_representation)))
        OR
        (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'CAMERA_IMAGE_3D_WITH_SCALE' IN TYPEOF(it2))
        AND NOT (
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION_REPRESENTATION'
        IN TYPEOF (it2\mapped_item.mapping_source.mapped_representation) ))
        ))) = 0))) = 0;
  WR3:  (SIZEOF(QUERY(ps <* USEDIN (SELF\presentation_area,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'PRESENTATION_SIZE.UNIT') | ((ps.size\planar_extent.size_in_x <= 0)
        OR
        (ps.size\planar_extent.size_in_y <= 0)))) = 0)
        AND
        (SIZEOF(QUERY(ais <* USEDIN (SELF\presentation_area,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AREA_IN_SET.AREA') |
        (SIZEOF(QUERY(ps <* USEDIN (ais,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'PRESENTATION_SIZE.UNIT') |
```

```
        ((ps.size\planar_extent.size_in_x <= 0)
        OR
        (ps.size\planar_extent.size_in_y <= 0)))) > 0))) = 0);
  WR4:  (SIZEOF(QUERY(ps <* USEDIN (SELF\presentation_area,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'PRESENTATION_SIZE.UNIT') |
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AXIS2_PLACEMENT_2D' IN TYPEOF (ps.size.placement)))) = 1)
        AND
        (SIZEOF(QUERY(ps <* USEDIN (SELF\presentation_area,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'PRESENTATION_SIZE.UNIT') |
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AXIS2_PLACEMENT_3D' IN TYPEOF (ps.size.placement)))) = 0)
        OR
        ((SIZEOF(QUERY(ais <* USEDIN (SELF\presentation_area,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AREA_IN_SET.AREA') |
        (SIZEOF(QUERY(ps <* USEDIN (ais,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'PRESENTATION_SIZE.UNIT') |
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AXIS2_PLACEMENT_2D' IN TYPEOF (ps.size.placement)))) = 1))) = 1)
        AND
        (SIZEOF(QUERY(ais <* USEDIN (SELF\presentation_area,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AREA_IN_SET.AREA') |
        (SIZEOF(QUERY(ps <* USEDIN (ais,
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'PRESENTATION_SIZE.UNIT') |
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'AXIS2_PLACEMENT_3D' IN TYPEOF (ps.size.placement)))) = 0))) = 1));
END_ENTITY;
(*
```

Formal propositions:

WR1: The items of a **mechanical_design_geometric_presentation_area** shall only be **axis2_placements** or **mapped_items**. In the latter case the **mapped_representation** of the **representation_map** that is the **mapping_source** of such a **mapped_item** shall be a **presentation_view**.

WR2: The items of a **presentation_view** shall only be **axis2_placements** or **mapped_items**. In the latter case a **mapped_item** may be of type **camera_image_3d_with_scale** with the **mapped_representation** of the **representation_map** that is the **mapping_source** of such a **mapped_item** being a **mechanical_design_geometric_presentation_representation**. If the **mapped_item** is not a **camera_image_3d_with_scale**, the **mapped_representation** of the **representation_map** that is the **mapping_source** of this mapped_item shall be a different **presentation_view**.

NOTE - If a user of this part of ISO 10303 includes in addition to **camera_image_3d_with_scale** other subtypes of **mapped_item** into a schema, additional rules may be required to exclude these subtypes to be

instantiated in a **presentation_view**. This part does not hinder the instantiation of subtypes of **mapped_item** that are not specified in this part.

WR3: The rectangular size of the **mechanical_design_geometric_presentation_area** shall be specified by positive values.

WR4: The drawing space of a **mechanical_design_geometric_presentation_area** shall be specified in a 2D co-ordinate system.

Informal propositions:

IP1: The **mapping_origin** of a **camera_usage** shall be a **camera_model_d3**, but shall not be one of its subtypes.

4.2.5 mechanical_design_geometric_presentation_representation

A **mechanical_design_geometric_presentation_representation** specifies the shape and optionally related presentation styles that shall be viewed in a **mechanical_design_geometric_presentation_area**. The entity is a subtype of representation. All items of a **mechanical_design_geometric_presentation_representation** shall be either **representation_items** that describe shape or **shape_representations**. Such items may or may not be styled. An item may be a **mapped_item**. The use of styles and style attributes for points, curves, and surfaces is restricted.

EXPRESS specification:

```
*)
ENTITY mechanical_design_geometric_presentation_representation
  SUBTYPE OF (representation);
WHERE
  WR1:  SIZEOF(QUERY(it <* SELF.items |
        NOT (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.MAPPED_ITEM',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.AXIS2_PLACEMENT',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CAMERA_MODEL_D3']
        * TYPEOF(it)) = 1))) = 0;
  WR2:  -- only shape_representations and
        -- mechanical_design_geometric_presentation_representations
        -- shall be referenced from mapped_items
        SIZEOF(QUERY(mi <* QUERY(it <* SELF.items |
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.MAPPED_ITEM'
        IN TYPEOF(it))) | NOT (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SHAPE_REPRESENTATION',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION_REPRESENTATION']
        * TYPEOF(mi\mapped_item.mapping_source.mapped_representation))
```

```
      = 1))) = 0;
WR3:  -- a mapped_item that is styled shall reference a
      -- shape_representation
      SIZEOF(QUERY(smi <* QUERY(si <* QUERY(it <* SELF.items |
      ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
      IN TYPEOF(it))) |
      ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.MAPPED_ITEM'
      IN TYPEOF(si\styled_item.item))) | NOT (
      ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'SHAPE_REPRESENTATION' IN TYPEOF (smi\styled_item.
      item\mapped_item.mapping_source.mapped_representation))) )) = 0;
WR4:  SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
      IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
      NOT (SIZEOF(QUERY(pss <* psa.styles | NOT (SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.POINT_STYLE',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE']
      * TYPEOF(pss)) = 1))) = 0))) = 0))) = 0;
WR5:  SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
      IN TYPEOF(it)) |
      NOT (SIZEOF(QUERY(psbc <* QUERY(psa <* si\styled_item.styles |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'PRESENTATION_STYLE_BY_CONTEXT' IN TYPEOF(psa)) | NOT (SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'REPRESENTATION_ITEM',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.REPRESENTATION']
      * TYPEOF(psbc\presentation_style_by_context.style_context))
      = 1))) = 0))) = 0;
WR6:  SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
      IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
      NOT (SIZEOF(QUERY(ps <* QUERY(pss <* psa.styles |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.POINT_STYLE'
      IN TYPEOF(pss)) | NOT
      (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'POSITIVE_LENGTH_MEASURE' IN TYPEOF (ps\point_style.marker_size))
      AND (SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.COLOUR_RGB',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'DRAUGHTING_PRE_DEFINED_COLOUR']
      * TYPEOF(ps\point_style.marker_colour))
      = 1)))) = 0))) = 0))) = 0;
WR7:  SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
      IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
      NOT (SIZEOF(QUERY(cs <* QUERY(pss <* psa.styles |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE'
      IN TYPEOF(pss)) | NOT((SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.COLOUR_RGB',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
```

```
        'DRAUGHTING_PRE_DEFINED_COLOUR']
        * TYPEOF(cs\curve_style.curve_colour)) = 1)
        AND
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'POSITIVE_LENGTH_MEASURE' IN TYPEOF (cs\curve_style.curve_width))
        AND (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE_FONT',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT']
        * TYPEOF(cs\curve_style.curve_font)) = 1)))) = 0))) = 0))) = 0;
  WR8:  SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
        IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
        NOT (SIZEOF(QUERY(ssu <* QUERY(pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF(pss)) |
        NOT ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_SIDE_STYLE' IN TYPEOF
        (ssu\surface_style_usage.style)))) = 0))) = 0))) = 0;
  WR9:  SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
        IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
        NOT (SIZEOF(QUERY(ssu <* QUERY(pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF(pss)) | NOT (SIZEOF(QUERY(sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        NOT (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_PARAMETER_LINE',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_CONTROL_GRID',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_SILHOUETTE',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_SEGMENTATION_CURVE',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_FILL_AREA',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_BOUNDARY']
        * TYPEOF(sses)) = 1))) = 0))) = 0))) = 0))) = 0;
  WR10: SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
        IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
        NOT (SIZEOF(QUERY(ssu <* QUERY(pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF(pss)) | NOT (SIZEOF(QUERY(sspl <* QUERY(sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_PARAMETER_LINE' IN TYPEOF(sses)) |
        NOT (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE'
        IN TYPEOF
        (sspl\surface_style_parameter_line.style_of_parameter_lines))
```

```
      AND (SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.COLOUR_RGB',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'DRAUGHTING_PRE_DEFINED_COLOUR']
      * TYPEOF(sspl\surface_style_parameter_line.
      style_of_parameter_lines\curve_style.curve_colour)) = 1)
      AND (
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'POSITIVE_LENGTH_MEASURE' IN TYPEOF
      (sspl\surface_style_parameter_line.
      style_of_parameter_lines\curve_style.curve_width))
      AND (SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE_FONT',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.'+
      'DRAUGHTING_PRE_DEFINED_CURVE_FONT']
      * TYPEOF(sspl\surface_style_parameter_line.
      style_of_parameter_lines\curve_style.curve_font)) = 1))))
      = 0))) = 0))) = 0))) = 0;
WR11: SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
      IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
      NOT (SIZEOF(QUERY(ssu <* QUERY(pss <* psa.styles |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE'
      IN TYPEOF(pss)) | NOT (SIZEOF(QUERY(sscg <* QUERY(sses <*
      ssu\surface_style_usage.style\surface_side_style.styles |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'SURFACE_STYLE_CONTROL_GRID' IN TYPEOF(sses)) |
      NOT (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE'
      IN TYPEOF (sscg\surface_style_control_grid.style_of_control_grid))
      AND (SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.COLOUR_RGB',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'DRAUGHTING_PRE_DEFINED_COLOUR']
      * TYPEOF(sscg\surface_style_control_grid.
      style_of_control_grid\curve_style.curve_colour)) = 1)
      AND
      ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'POSITIVE_LENGTH_MEASURE' IN TYPEOF
      (sscg\surface_style_control_grid.
      style_of_control_grid\curve_style.curve_width))
      AND (SIZEOF(
      ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE_FONT',
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
      'DRAUGHTING_PRE_DEFINED_CURVE_FONT']
      * TYPEOF(sscg\surface_style_control_grid.
      style_of_control_grid\curve_style.curve_font)) = 1))))
      = 0))) = 0))) = 0))) = 0;
WR12: SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
      IN TYPEOF(it)) |
      NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
      NOT (SIZEOF(QUERY(ssu <* QUERY(pss <* psa.styles |
```

```
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF(pss)) | NOT (SIZEOF(QUERY(sssh <* QUERY(sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_SILHOUETTE' IN TYPEOF(sses)) |
        NOT (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE'
        IN TYPEOF (sssh\surface_style_silhouette.style_of_silhouette))
        AND (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'DRAUGHTING_PRE_DEFINED_COLOUR']
        * TYPEOF(sssh\surface_style_silhouette.
        style_of_silhouette\curve_style.curve_colour)) = 1)
        AND
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'POSITIVE_LENGTH_MEASURE' IN TYPEOF
        (sssh\surface_style_silhouette.style_of_silhouette\curve_style.
        curve_width))
        AND (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE_FONT',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT']
        * TYPEOF(sssh\surface_style_silhouette.
        style_of_silhouette\curve_style.curve_font)) = 1))))
        = 0))) = 0))) = 0))) = 0;
  WR13: SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
        IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
        NOT (SIZEOF(QUERY(ssu <* QUERY(pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF(pss)) | NOT (SIZEOF(QUERY(sssc <* QUERY(sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_SEGMENTATION_CURVE' IN TYPEOF(sses)) |
        NOT (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE'
        IN TYPEOF
        (sssc\surface_style_segmentation_curve.style_of_segmentation_curve))
        AND (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'DRAUGHTING_PRE_DEFINED_COLOUR']
        * TYPEOF(sssc\surface_style_segmentation_curve.
        style_of_segmentation_curve\curve_style.curve_colour)) = 1)
        AND
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'POSITIVE_LENGTH_MEASURE' IN TYPEOF
        (sssc\surface_style_segmentation_curve.
        style_of_segmentation_curve\curve_style.curve_width))
        AND (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE_FONT',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT']
```

```
        * TYPEOF(sssc\surface_style_segmentation_curve.
        style_of_segmentation_curve\curve_style.curve_font)) = 1))))
        = 0))) = 0))) = 0))) = 0;
  WR14: SIZEOF(QUERY(si <* QUERY(it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.STYLED_ITEM'
        IN TYPEOF(it)) | NOT (SIZEOF(QUERY(psa <* si\styled_item.styles |
        NOT (SIZEOF(QUERY(ssu <* QUERY(pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF(pss)) | NOT (SIZEOF(QUERY(ssbd <* QUERY(sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'SURFACE_STYLE_BOUNDARY' IN TYPEOF(sses)) |
        NOT (('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE'
        IN TYPEOF (ssbd\surface_style_boundary.style_of_boundary))
        AND (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'DRAUGHTING_PRE_DEFINED_COLOUR']
        * TYPEOF(ssbd\surface_style_boundary.
        style_of_boundary\curve_style.curve_colour)) = 1)
        AND
        ('AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'POSITIVE_LENGTH_MEASURE' IN TYPEOF (ssbd\surface_style_boundary.
        style_of_boundary\curve_style.curve_width))
        AND (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.CURVE_STYLE_FONT',
        'AIC_MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION.' +
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT']
        * TYPEOF(ssbd\surface_style_boundary.
        style_of_boundary\curve_style.curve_font)) = 1)))) = 0)))
        = 0))) = 0))) = 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: Each entity in the set of items shall be a **styled_item**, a **mapped_item**, an **axis2_placement**, or a **camera_model_d3**.

WR2: The **mapped_representation** of the **representation_map** that is the **mapping_source** of a **mapped_item** in a **mechanical_design_geometric_presentation_representation** shall be a **shape_representation** or another **mechanical_design_geometric_presentation_representation**.

WR3: The item of a **styled_item** may be a **mapped_item** only, if the **mapped_item** has a **shape_representation** as its **mapped_representation**.

WR4: Each item in the set of styles of a **presentation_style_assignment** shall be either a **point_style**, **curve_style**, or **surface_style_usage**.

WR5: The **style_context** attribute of a **presentation_style_by_context** shall be either a representation or a **representation_item**.

WR6: For each **point_style** in the set of styles of a **presentation_style_assignment** the **marker_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **marker_size** attribute shall be a **positive_length_measure**.

WR7: For each **curve_style** in the set of styles of a **presentation_style_assignment** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**.

WR8: The style attribute of each **surface_style_usage** in the set of styles of a **presentation_style_assignment** shall be a **surface_side_style**.

WR9: Each item in the set of styles of a **surface_side_style** shall be either a **surface_style_parameter_line**, **surface_style_control_grid**, **surface_style_silhouette**, **surface_style_segmentation_curve**, **surface_style_fill_area**, or a **surface_style_boundary**.

WR10: The **style_of_parameter_lines** attribute of a **surface_style_parameter_line** shall be a **curve_style**, and for this **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**.

WR11: The **style_of_control_grid** attribute of a **surface_style_control_grid** shall be a **curve_style**, and for this **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**.

WR12: The **style_of_silhouette** attribute of a **surface_style_silhouette** shall be a **curve_style**, and for this **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**.

WR13: The **style_of_segmentation_curve** attribute of a **surface_style_segmentation_curve** shall be a **curve_style**, and for this **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**.

WR14: The **style_of_boundary** attribute of a **surface_style_boundary** shall be a **curve_style**, and for this **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**.

4.3 aic_mechanical_design_geometric_presentation function definition: aspect ratio

The **aspect_ratio** function returns a **positive_ratio_measure** that is the ratio of length to height for a given **planar_box**. The **planar_box** shall be specified using only positive values.

EXPRESS specification:

```
*)
FUNCTION aspect_ratio (p : planar_box) : positive_ratio_measure;
  RETURN (p.size_in_x / p.size_in_y);
END_FUNCTION;
(*
```

Argument definitions:

p: The input **planar_box** to be checked.

EXPRESS specification:

```
*)
END_SCHEMA;
(*
```

Annex A
(normative)

Short names of entities

Table A.1 provides the short names of entities specified in this part of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

Table A.1 – Short names of entities

Entity names	Short names
CAMERA_IMAGE_3D_WITH_SCALE	CI3WS
DRAUGHTING_PRE_DEFINED_COLOUR	DPDC
DRAUGHTING_PRE_DEFINED_CURVE_FONT	DPDCF
MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION_AREA	MDGPA
MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION_REPRESENTATION	MDGPR

Annex B
(normative)

Information object registration

B.1 Document identification

To provide for unambiguous identification of an information object in an open system, the object identifier

{ iso standard 10303 part(517) version(1) }

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

B.2 Schema identification

To provide for unambiguous identification of the aic_mechanical_design_geometric_presentation_schema in an open information system, the object identifier

{ iso standard 10303 part(517) version(1) object(1) aic-mechanical-design-geometric-presentation-schema(1) }

is assigned to the aic_mechanical_design_geometric_presentation_schema schema (see clause 4). The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

Annex C
(informative)

EXPRESS-G diagrams

Figure C.1 through Figure C.14 correspond to the EXPRESS generated from the short listing given in clause 4 using the interface specifications of ISO 10303-11. The diagrams use the EXPRESS-G graphical notation for the EXPRESS language. EXPRESS-G is defined in annex D of ISO 10303-11.

NOTE 1 - The following select types: character_spacing_select, hiding_or_blanking_select, invisibility_context, layered_item, measure_value, presentation_representation_select, trimming_select, and vector_or_direction are interfaced into the AIC expanded listing according to the implicit interface rules of ISO 10303-11. These select types are not referenced by other entities in this part of ISO 10303.

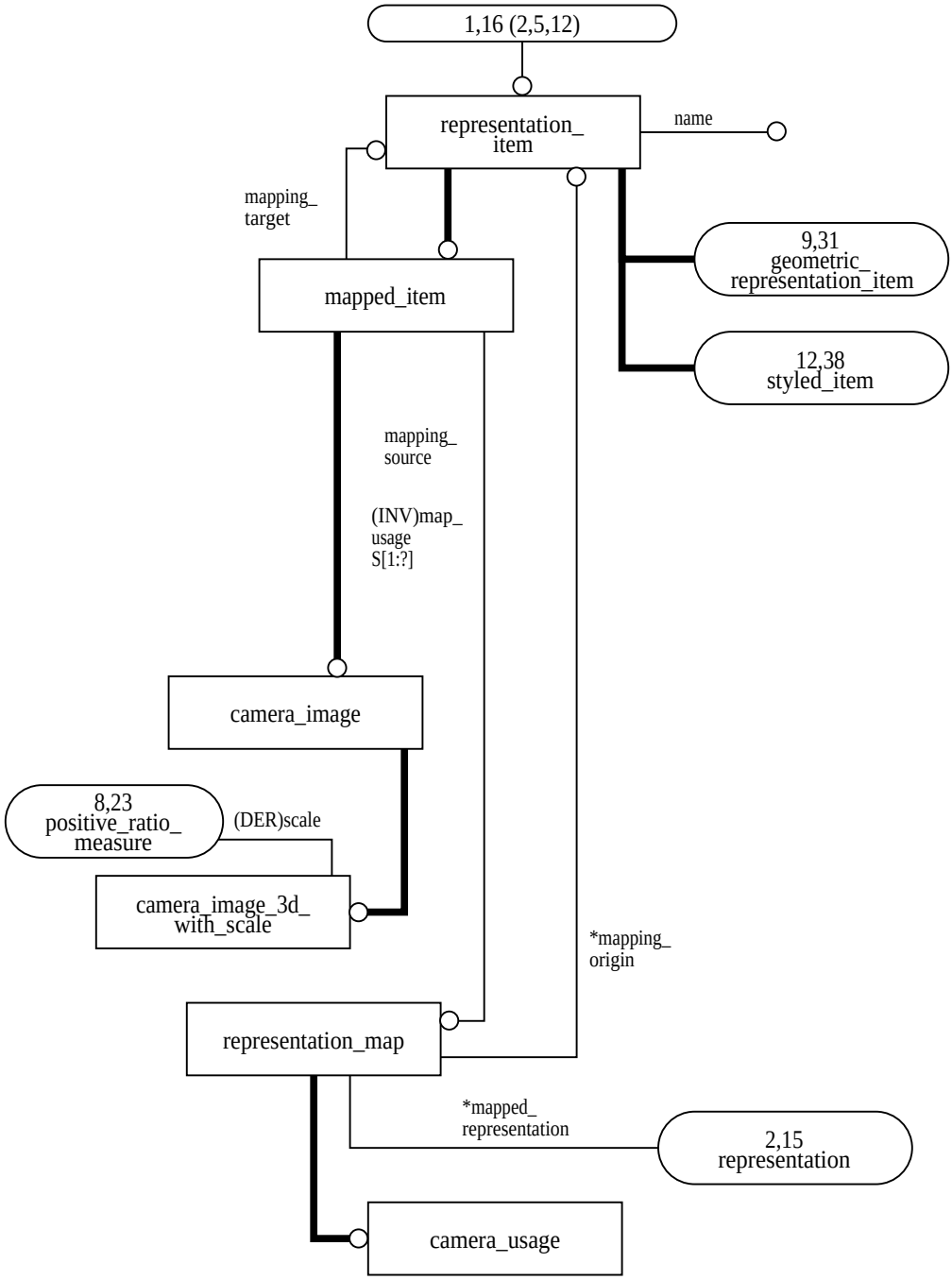

Figure C.1 – AIC expanded listing diagram in EXPRESS–G: 1 of 14

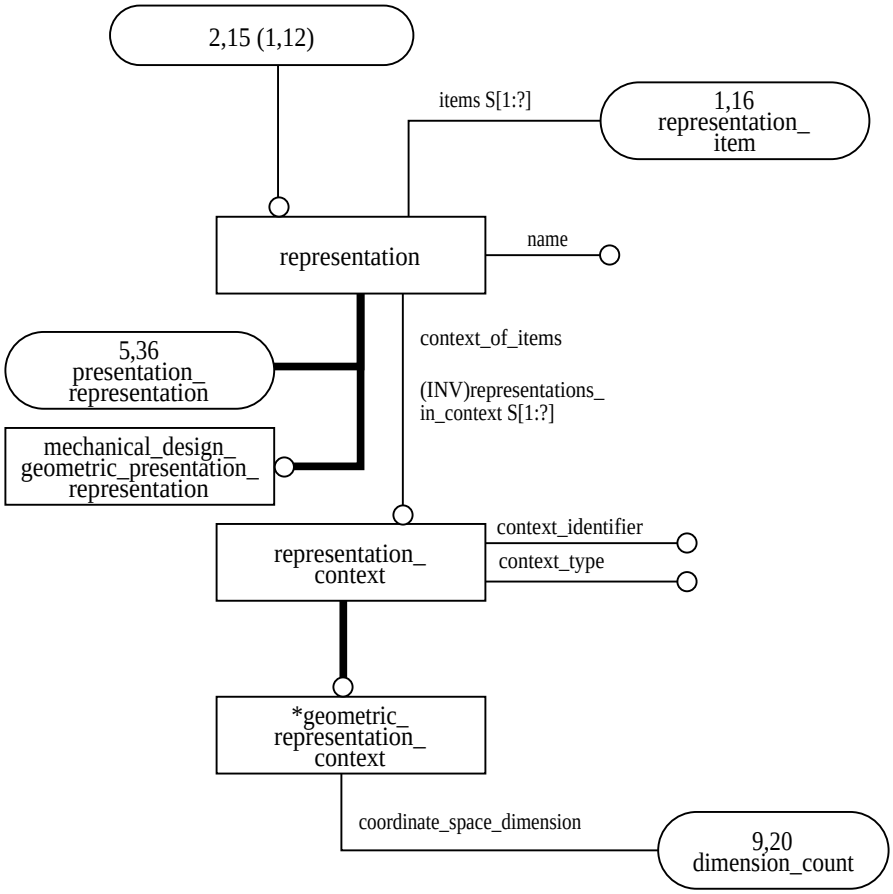

Figure C.2 – AIC expanded listing diagram in EXPRESS–G: 2 of 14

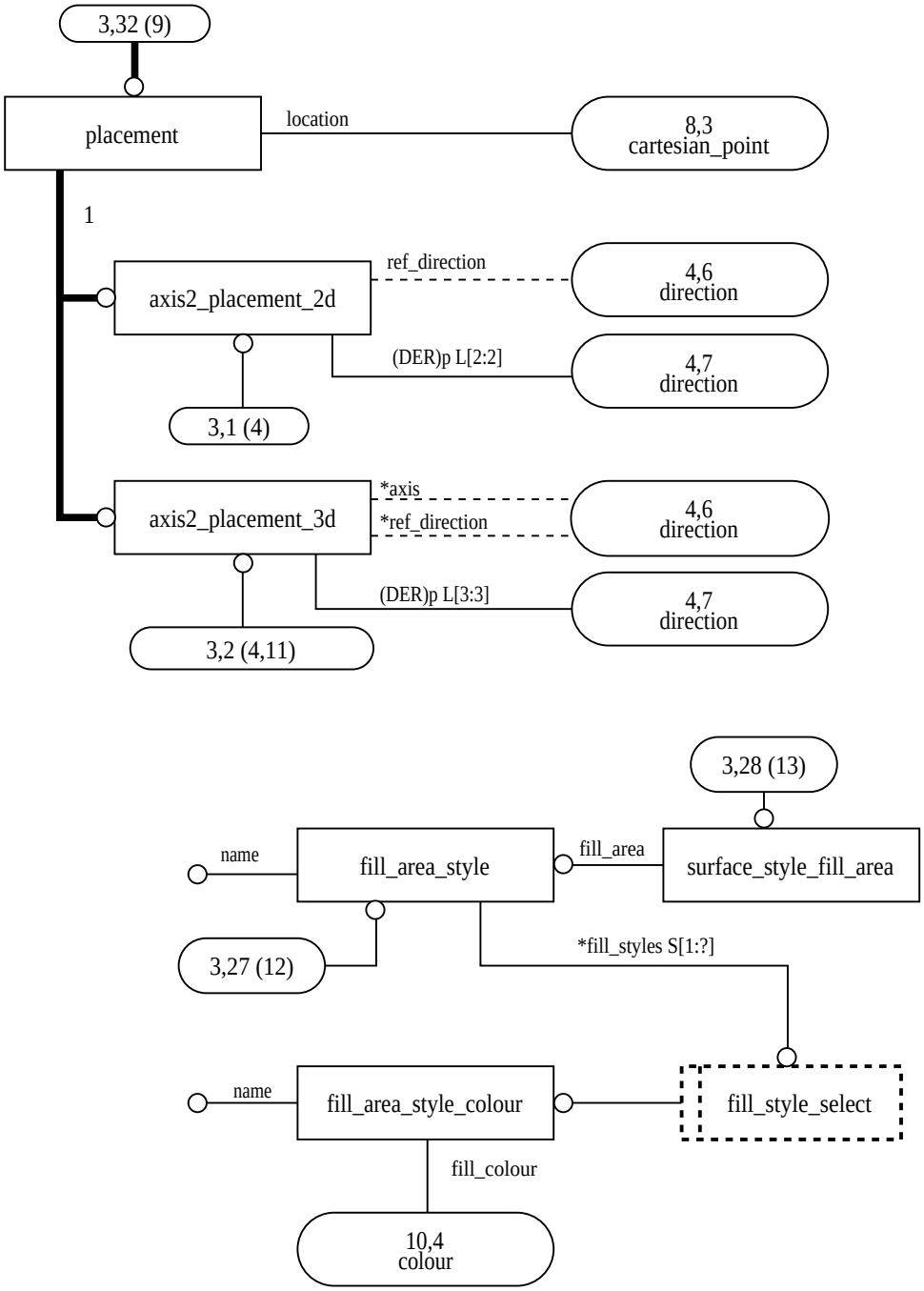

Figure C.3 – AIC expanded listing diagram in EXPRESS–G: 3 of 14

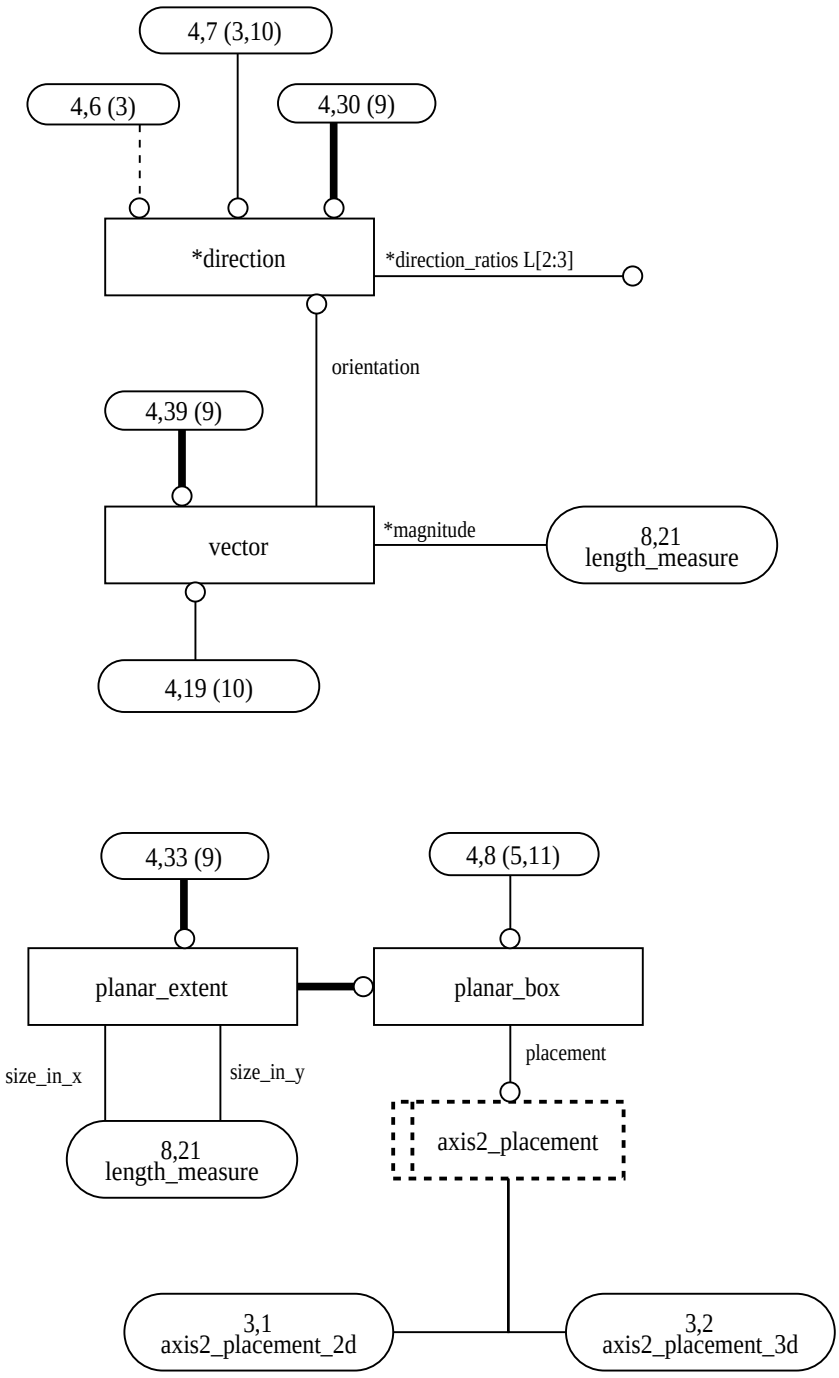

Figure C.4 – AIC expanded listing diagram in EXPRESS–G: 4 of 14

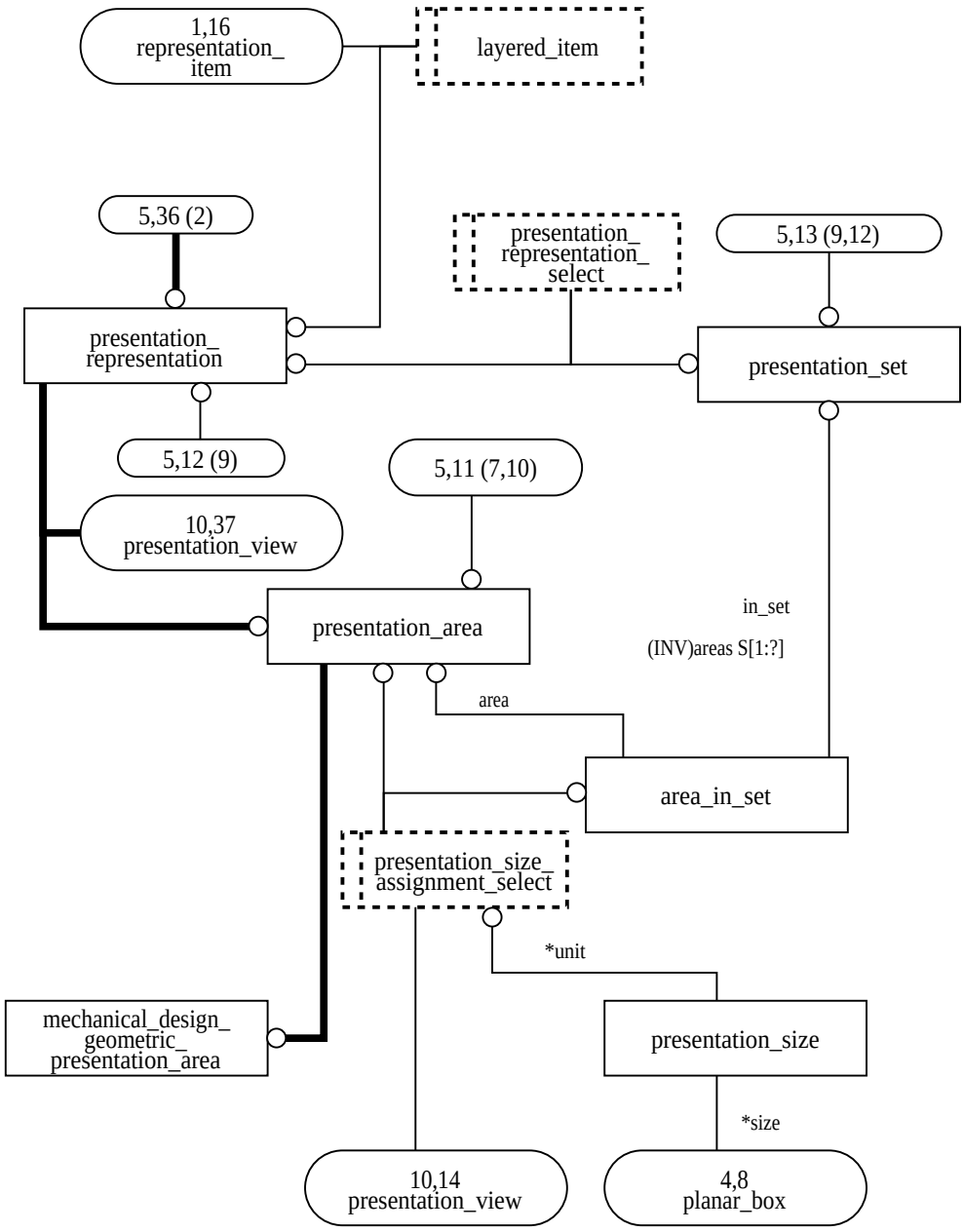

Figure C.5 – AIC expanded listing diagram in EXPRESS–G: 5 of 14

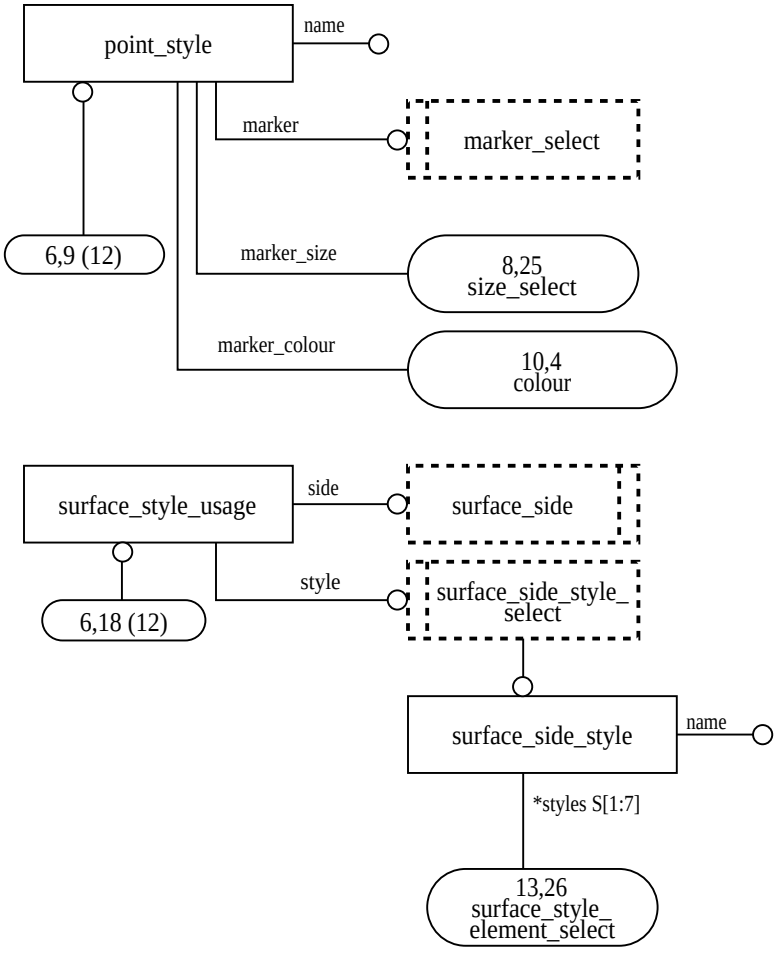

Figure C.6 – AIC expanded listing diagram in EXPRESS–G: 6 of 14

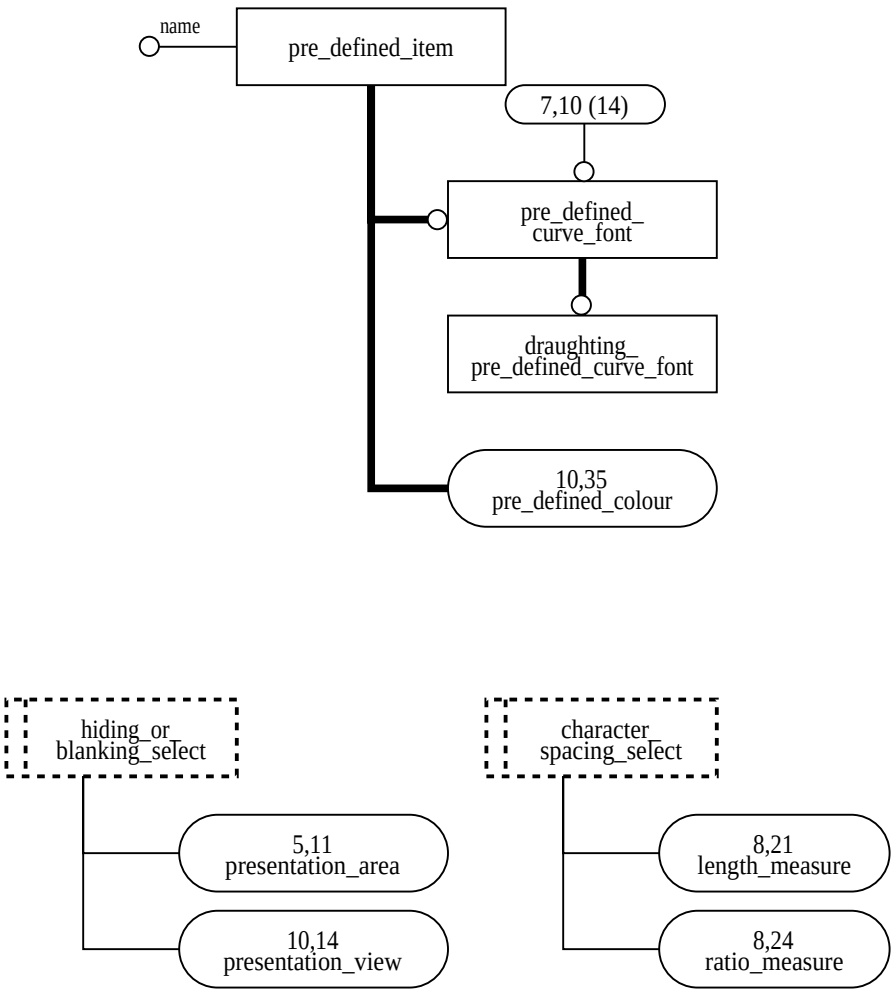

Figure C.7 – AIC expanded listing diagram in EXPRESS–G: 7 of 14

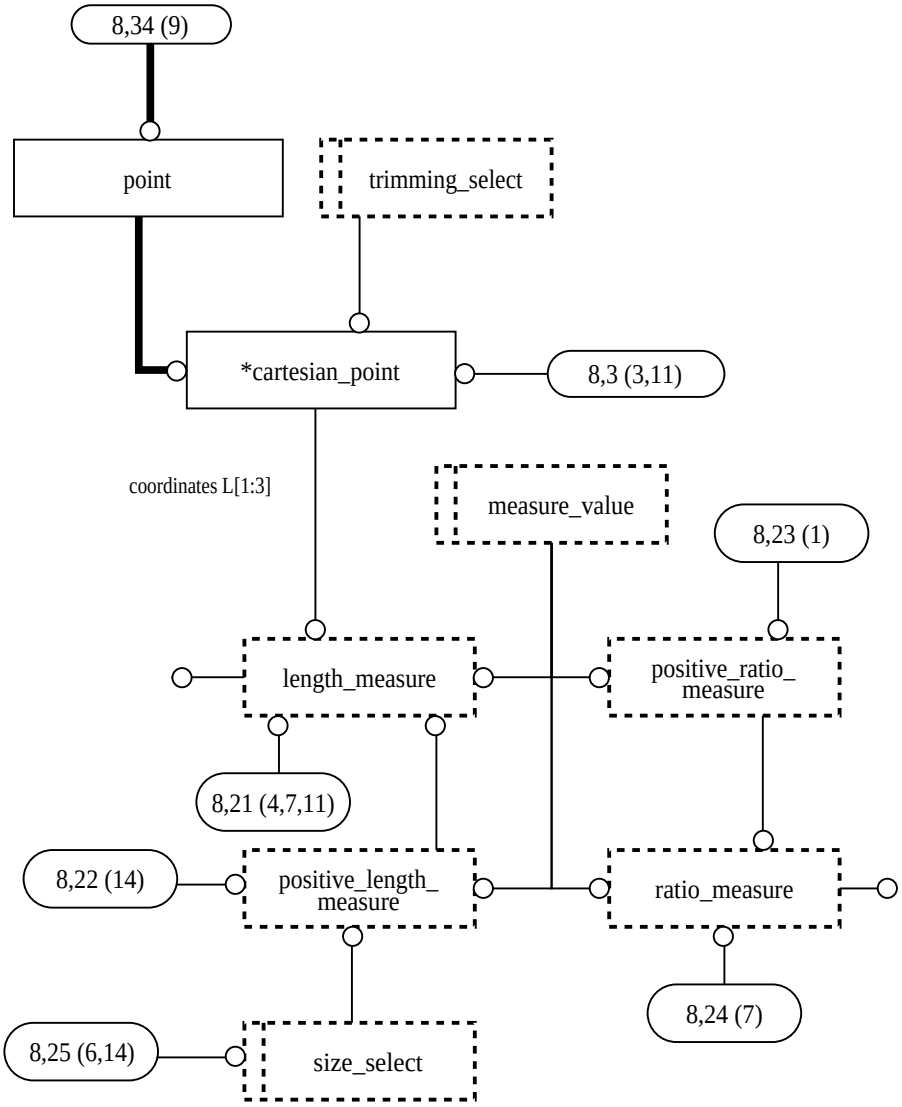

Figure C.8 – AIC expanded listing diagram in EXPRESS–G: 8 of 14

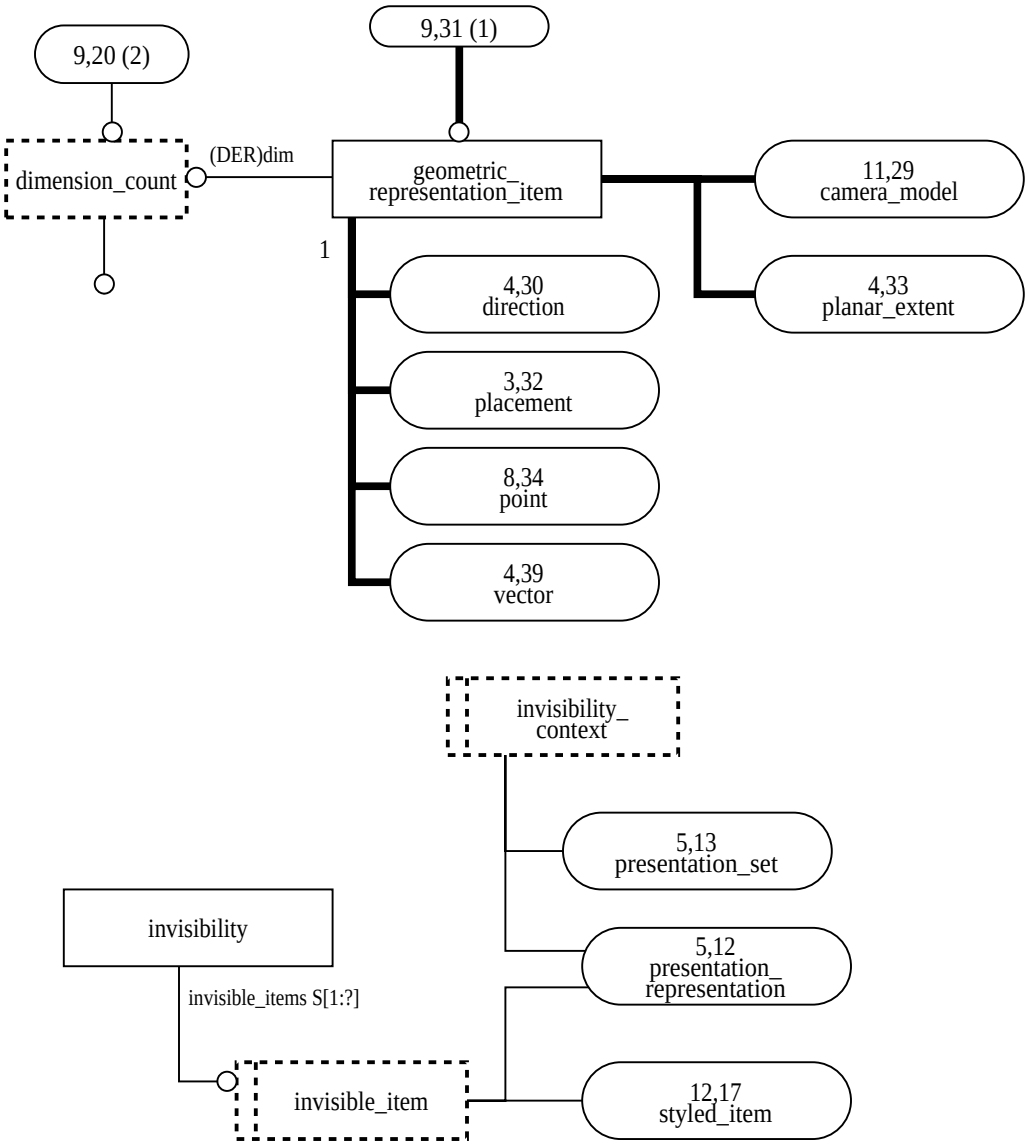

Figure C.9 – AIC expanded listing diagram in EXPRESS–G: 9 of 14

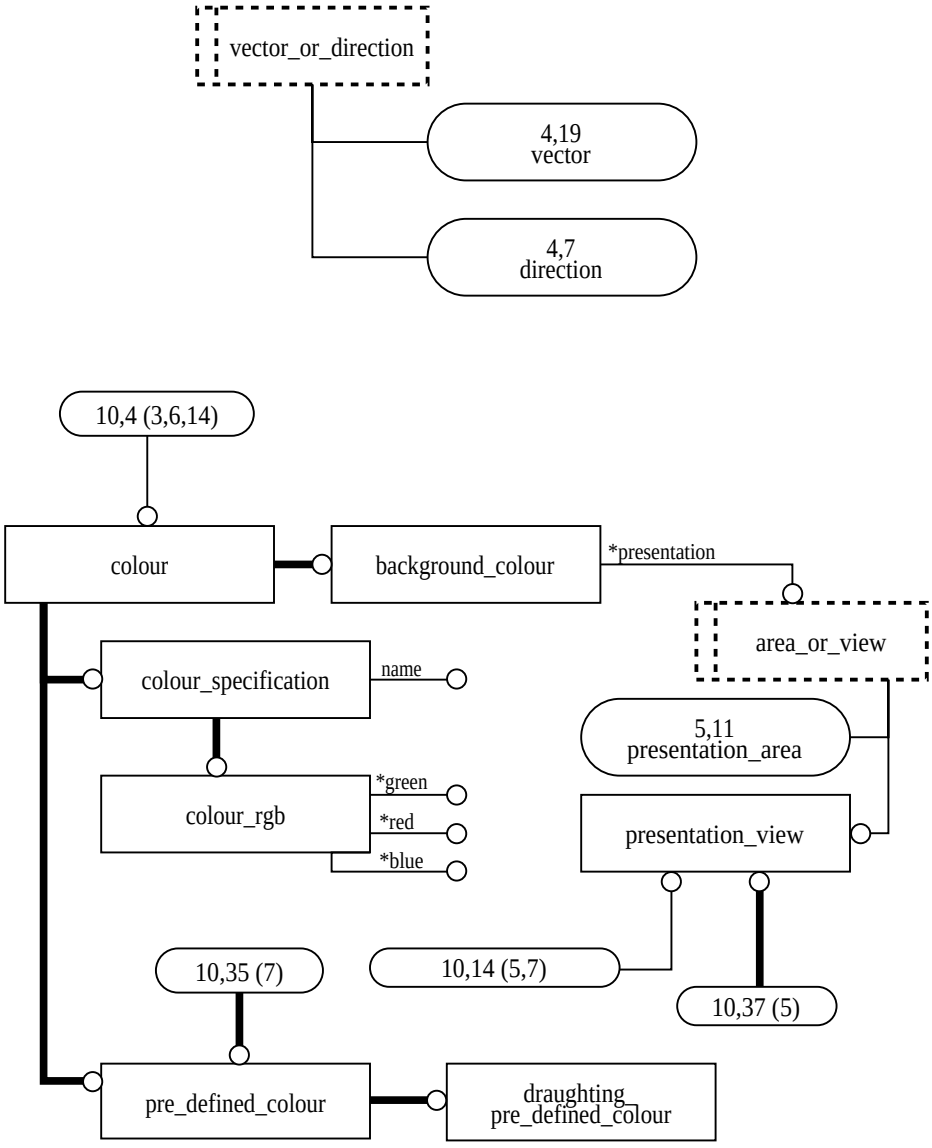

Figure C.10 – AIC expanded listing diagram in EXPRESS–G: 10 of 14

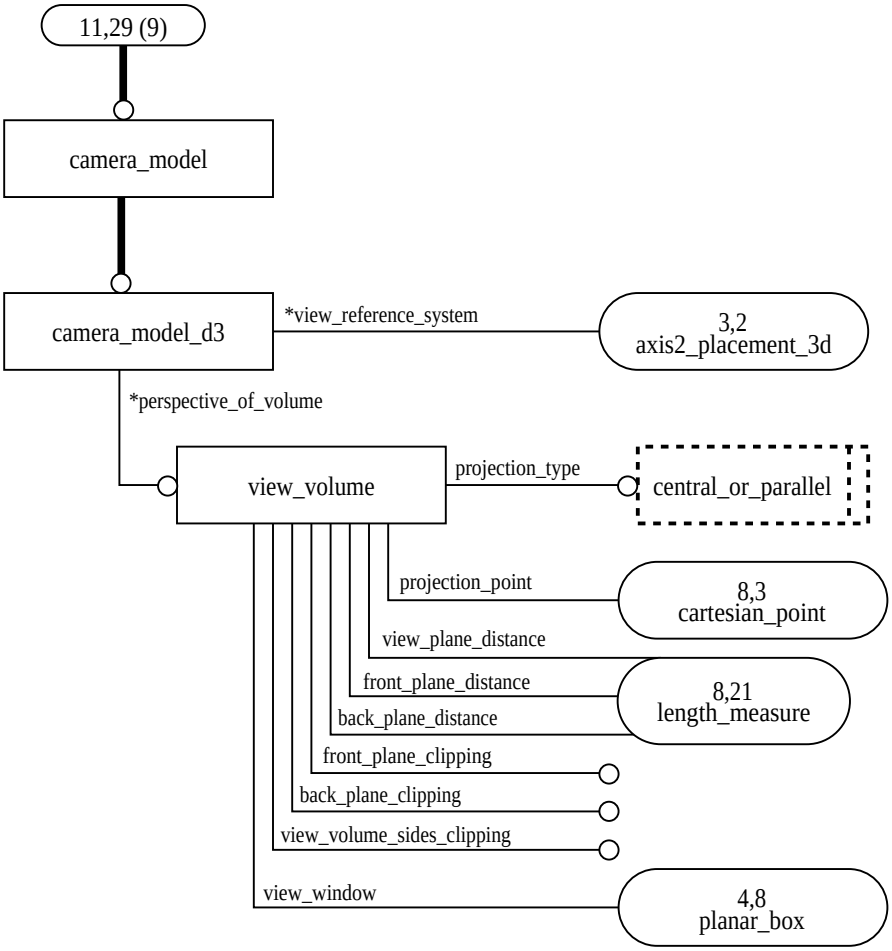

Figure C.11 – AIC expanded listing diagram in EXPRESS–G: 11 of 14

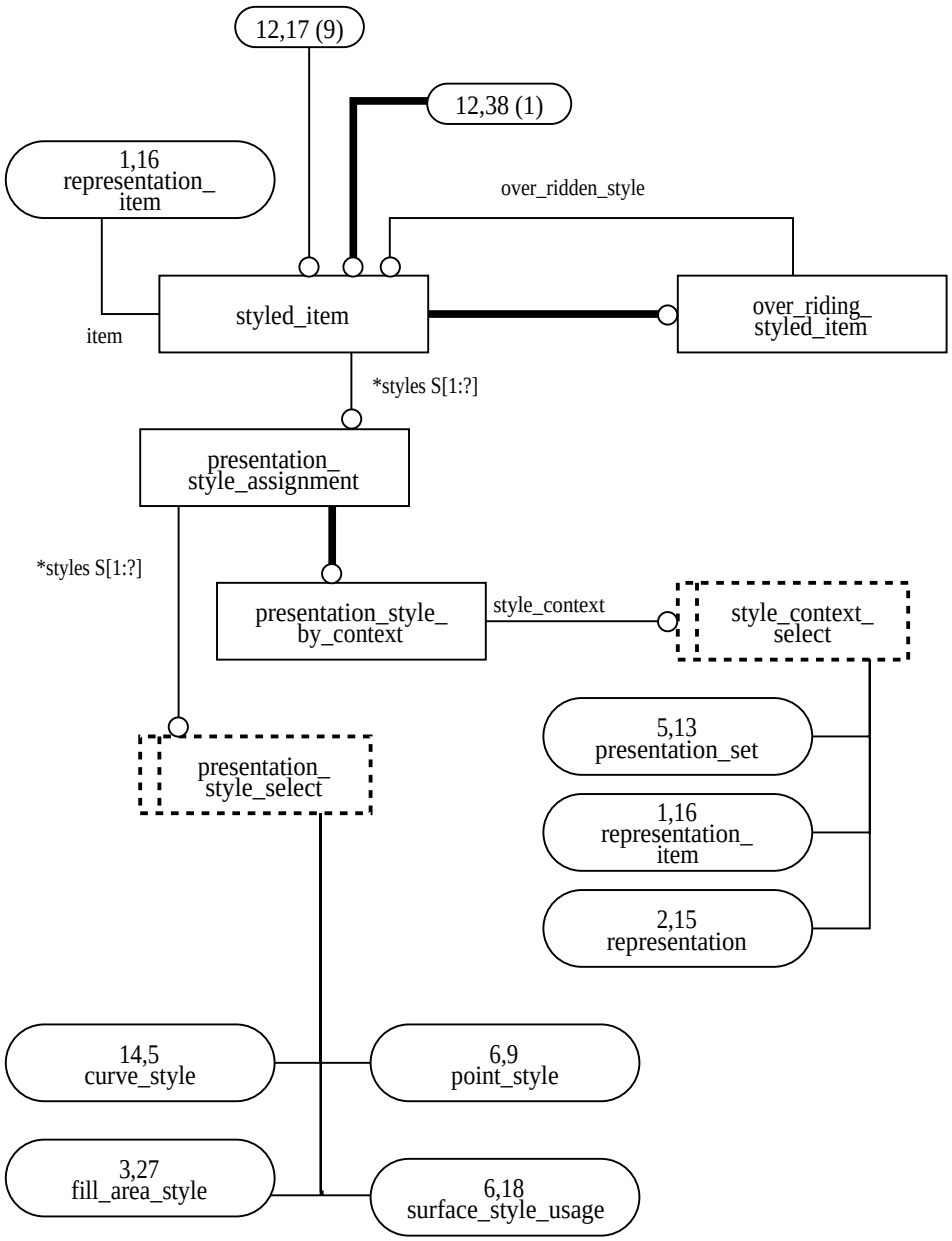

Figure C.12 – AIC expanded listing diagram in EXPRESS–G: 12 of 14

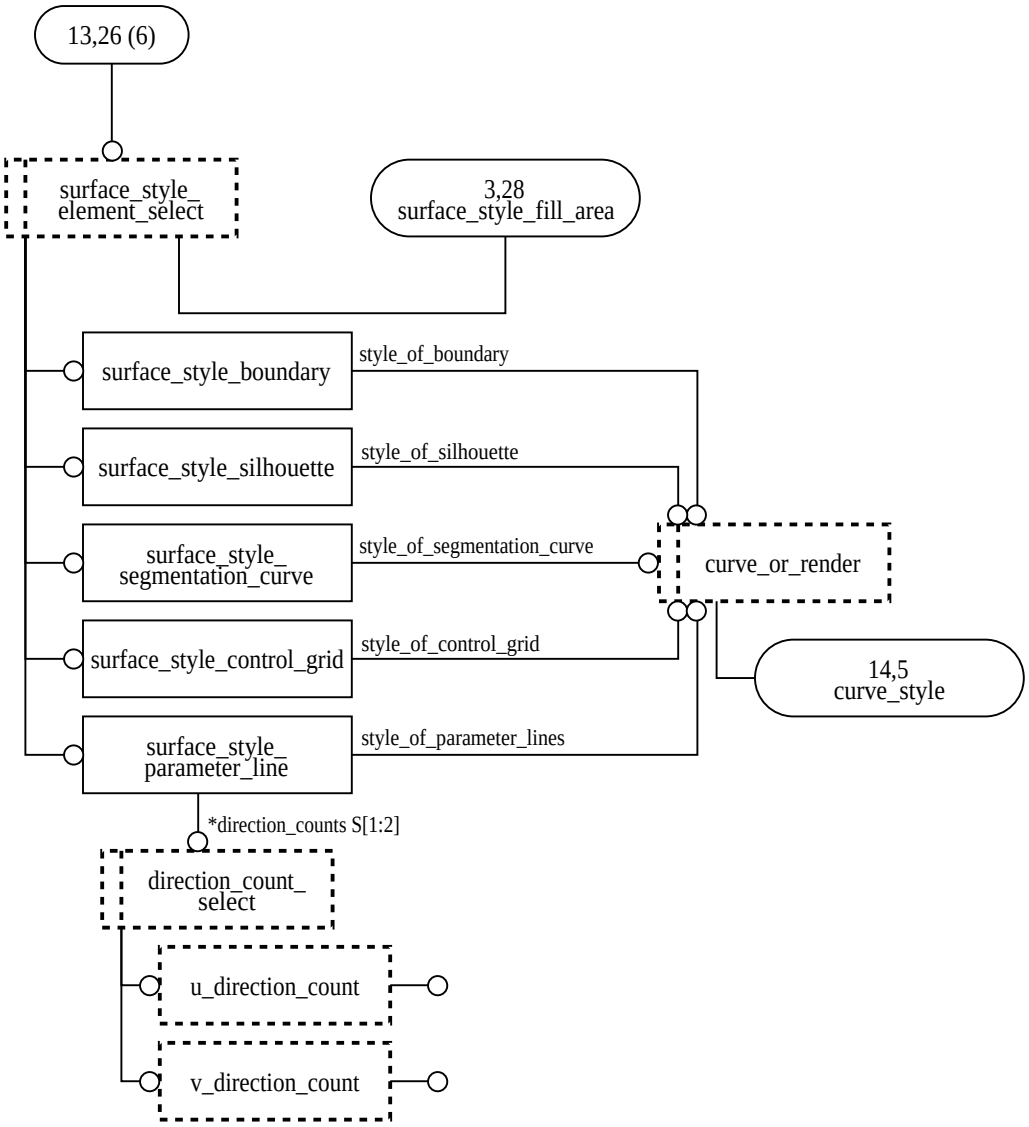

Figure C.13 – AIC expanded listing diagram in EXPRESS–G: 13 of 14

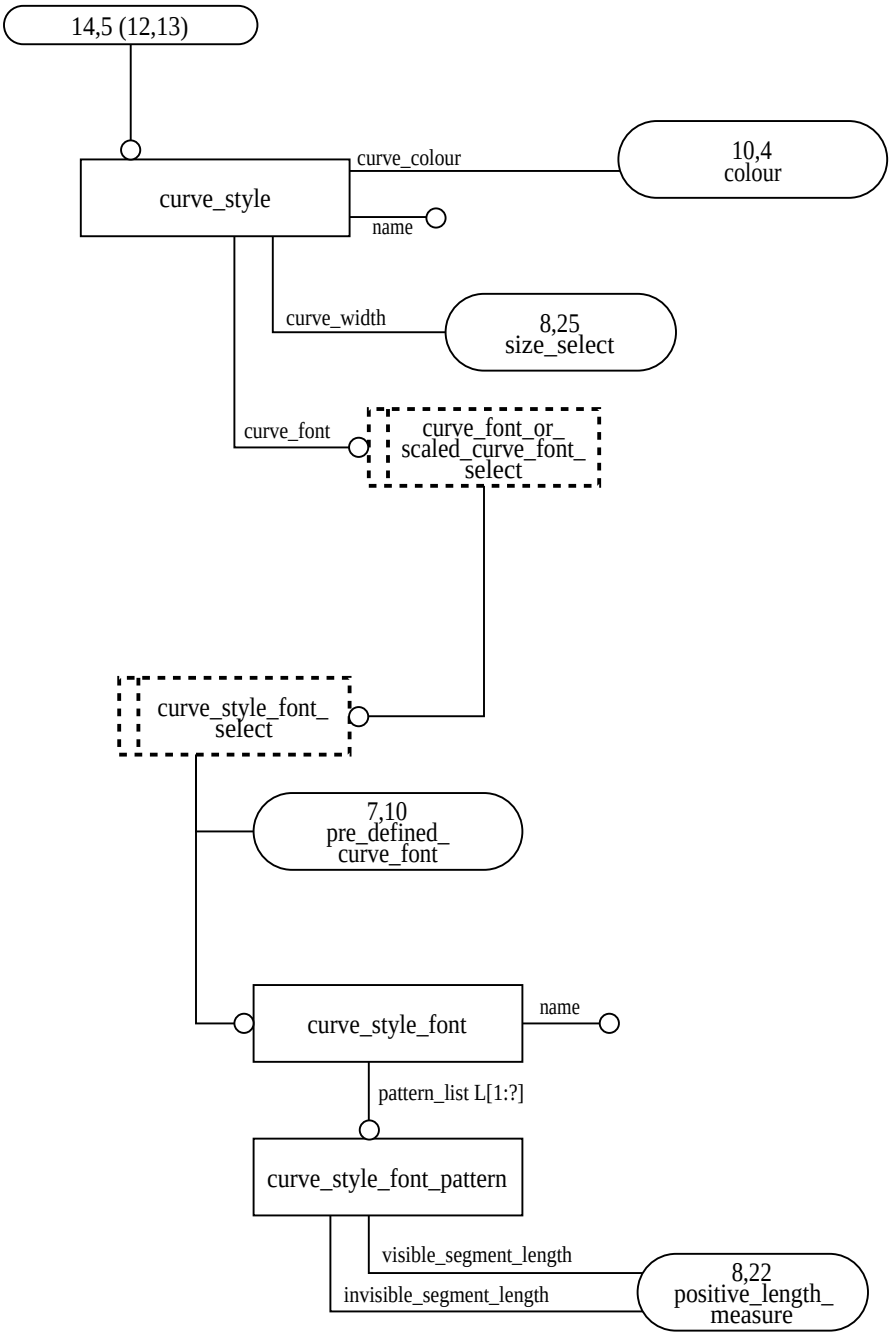

Figure C.14 – AIC expanded listing diagram in EXPRESS–G: 14 of 14

Annex D
(informative)

Computer interpretable listings

This annex references a listing of the EXPRESS entity names and corresponding short names as specified in this part of ISO 10303. It also provides a listing of each EXPRESS schema specified in this part of ISO 10303 without comments or other explanatory text. These listings are available in computer-interpretable form and can be found at the following URLs:

Short names: http://www.mel.nist.gov/div826/subject/apde/snr/

EXPRESS: http://www.mel.nist.gov/step/parts/part517/is/

If there is difficulty accessing these sites contact ISO Central Secretariat or contact the ISO TC 184/SC4 Secretariat directly at: sc4sec@cme.nist.gov.

NOTE - The information provided in computer-interpretable form at the above URLs is informative. The information that is contained in the body of this part of ISO 10303 is normative.

Index